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Development of tissue-engineered constructs for ossicular chain replacement

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Ossicular chain (OC) is the bony part of middle ear dedicated to sound transmission. Chronic inflammations, infections and traumas occurring in the lifespan result in a set of severe diseases known as "conductive hearing loss". To recover an acceptable hearing threshold, the damaged OC have to be surgically replaced with artificial prostheses. However, despite many efforts aimed at fabricating optimal replacements, all the synthetic prostheses are subject to extrusion, i.e., a type of rejection due to lack of biointegration. For these reasons, it is necessary to envision novel strategies for the OC substitution. In recent years, we have proposed an approach for OC reconstruction based on tissue engineering (TE), in which mesenchymal stromal cells (MSCs) are cultured under osteogenic differentiation regimen on bioresorbable 3D scaffolds up to obtain new bone substitutes with appropriate shape and dimensions (Danti et al., 2009; Danti et al., 2010). In this study, human MSCs were osteo-differentiated on different types of OC scaffolds fabricated in our laboratories. TE constructs were analyzed via biochemical assays, molecular biology and histo-morphological methods. An extensive analysis on native ossicles was performed to compare the results obtained in the constructs with the mature tissues. The results showed that the cells were viable, colonized the scaffolds and produced extracellular matrix molecules at intra- and extra-cellular level. MSC differentiation towards the osteogenic lineage was demonstrated by the production of mineralized matrix and specific osteogenic markers. Moreover, we assessed that all the investigated molecules were also expressed in the native tissues, even if at different expression levels, indicating that it was obtained a preliminary step for the creation of TE constructs to be employed, in perspective, as OC substitutes in the otologic surgery.

References

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